ARJUNA

JEE

LECTURE - 11

Mole Concept

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Q. How mamy concentration term is not effected by temperature change , mass % , (v/v) % , mole fraction , mole % , (w/v) % , PPM ,PPB

Ans batao

A 2

B 5

C 3

D 4

① $PPM = \frac{W_{solute}}{W_{sol^n}} \times 10^6$

① $PPB = \frac{W_{solute}}{W_{sol^n}} \times 10^9$

① $Mole\% = \frac{n_1}{n_1+n_2} \times 100$

① $mole\ fraction = \frac{n_1}{n_1+n_2}$

① $mass\% = \frac{W_{solute}}{W_{sol^n}} \times 10^2$

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Q. The mole fraction of glucose ($C_6H_{12}O_6$) in an aqueous binary solution is 0.1. The mass percentage of water in it, to the nearest integer, is

solute + solvent

(Jee-Main 2019) [JEE Main 2020-3 September (Morning)]

Soln → 2 to 3 minutes

$X_{glucose} = 0.1$

$X_{H_2O} = 0.9$

$$\frac{X_{glu}}{X_{H_2O}} = \frac{0.1}{0.9} = \frac{1}{9}$$

$$\frac{n_{glu}}{n_{H_2O}} = \frac{1}{9}$$

$n_{glu} = 1\,mole = 1 \times 180\,gram$

$n_{H_2O} = 9\,mole = 9 \times 18\,gram$

Mass % of H_2O

$$= \frac{W_{H_2O}}{W_{H_2O} + W_{glu}} \times 100$$

$$= \frac{9 \times 18}{9 \times 18 + 180} \times 100$$

$$= \frac{9 \times 18}{19 \times 18} \times 100$$

$$= \frac{900}{19} = 47.3 \simeq 47$$

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Molality

1 Kg solvent = 1000gram = 10^3 gram solvent

"total mole of solute dissolved in 1 Kg = 1000gram of solvent"

500 gram solvent = 2 mole solute

Q→ Molality of solution = 500g ⟶ 2mole

1000g ⟶ $\frac{2}{500} \times 1000 = 4$ mole

$M = \frac{2}{500} \times 10^3 = 4$ mole

Molality of sol^n = 4 mole

$$\text{Molality of solution (m)} = \frac{\text{Mole of sdute}}{\text{Mass of solvent (kg)}}$$

$$\text{Molality (m)} = \frac{\text{Mole of solute} \times 10^3}{\text{Mass of solvent (gram)}}$$

sahi hai

Q 4 gram NaOH dissolved in 90 gram water

Calculate molality of solution. (At wt → Na = 23, O = 16, H = 1)

Soln.

$$\text{molality of solution (m)} = \frac{\text{mole of solute}}{\text{Mass of solvent (g)}} \times 10^3$$

$$= \frac{\frac{4}{40}}{90} \times 1000$$

$$= \frac{4 \times 1000}{90 \times 40} = \frac{10}{9} = 1.1$$

$C_{SD} = 31$

(a) $m = \dfrac{\text{mole of solute}}{\text{Mass of solvent (gram)}} \times 10^3$

(b) $m = \dfrac{\text{mole of solute}}{(\text{Mass})_{\text{sol}^n.} - (\text{Mass})_{\text{solute}}} \times 10^3$

Molality in term of mass of solution

$d = \dfrac{m}{v}$

$m = d \times v$

$(\text{Mass})_{\text{sol}^n.} = d_{\text{sol}^n.} \times V_{\text{sol}^n}$

$\text{gram} = \dfrac{g}{ml} \times ml$ or $\text{gram} = \dfrac{g}{\text{litre}} \times \text{litre}$

(c) Molality of sol^n. in term of volume & density of sol^n.

$$m = \frac{(\text{mole})_{\text{solute}} \times 10^3}{(d_{\text{sol}^n.} \times V_{\text{sol}^n.}) - (\text{Mass})_{\text{solute}}}$$

Q 4 gram NaOH dissolved in 94 gram solution. Calculate molality of solution.

Sol^{n} – Mass of solute (NaOH) = 4 gram

Mass of solution = 94 gram

$$m = \frac{(\text{mole})_{\text{solute}}}{(\text{Mass})_{\text{sol}^{n}} - (\text{Mass})_{\text{solute}}} \times 10^{3}$$

$$\frac{\frac{4}{40} \times 10^{3}}{94-4} = \frac{4 \times 1000}{90 \times 40} = 1.1$$

Q density of 4% (w/v) solution of NaOH is 1.2 g/ml.
Calculate molality of sol^n.

(a) 1.1.

(b) 1.57

(c) 2.3

(d) None of these

Sol^n. mass of solute = 4 gram

Vol. of solution = 100ml

density of sol^n = 1.2 g/ml

$$m = \frac{(\text{mole})_{\text{solute}} \times 10^3}{d_{\text{sol}^n} \times V_{\text{sol}^n} - (\text{Mass})_{\text{solute}}}$$

$$= \frac{\frac{4}{40} \times 10^3}{1.2\frac{g}{ml} \times 100ml - 4} = \frac{0.1 \times 1000}{120-4} = \frac{100}{116} = 0.86$$

Q.

A molal solution is one that contains one mole of solute in

(1986)

$m = 1$ Ans batao

A 1000 g of solvent

B 1.0 L of solvent

C 1.0 L of solution

D 22.4 L solution

Unit of molality $= \frac{\text{mole of solute}}{\text{Mass of sol.(Kg)}} = \frac{\text{mole}}{\text{kg}} = \frac{\text{mole}}{\text{kg}} = \text{mole.kg}^{-1}$

$C_{SD}=32$ → molality in term of mass % of solute

given = Mass of solute = x %. (w/w)

$m = ?$

mass of solute = x gram

mass of solution = 100 gram

mass of solvent = (100 - x) gram

Q. 8 g of NaOH is dissolved in 18 g of H_2O. Mole fraction of NaOH in solution and molality (in mol kg^{-1}) of the solution respectively are (Jee-Main 2019)

(A) 0.2, 11.11

(B) 0.167, 22.20

(C) 0.2, 22.20

(D) 0.167, 11.11

180 sec or 3 minute

Mole fraction of NaOH $= \frac{n_{NaOH}}{n_{NaOH} + n_{H_2O}}$

$= \frac{8/40}{\frac{8}{40} + \frac{18}{18}} = \frac{\frac{1}{5}}{\frac{1}{5}+1} = \frac{0.2}{1.2} = \frac{1}{6}$

$\chi_{NaOH} = 0.167$

$m = \frac{8/40 \times 10^3}{18}$

$= \frac{0.2 \times 1000}{180}$

$= \frac{100}{9} = 11.11$

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Q. What would be the molality of 20% (mass/mass) aqueous solution of KI? (Molar mass of KI = 166 g mol^{-1}) 80gram

[2019 Main, 9 April I]

(A) 1.48

(B) 1.51

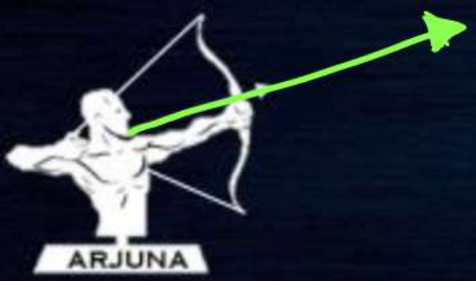
(C) 1.35

(D) 1.08

$$m = \frac{\frac{20}{166} \times 10^3}{80} \quad 250$$

$$= \frac{20 \times 1000}{166 \times 80} \quad 4$$

$$= \frac{250}{166} = 1.51$$



$C_{SD}=33$ molality of solution in term mole fraction of solute.

Given ⇒ Mole fraction of solute = 0.4

Sol^n = $X_{solvent}$ = 1 − 0.4 = 0.6

$\frac{n_{solute}}{n_{solvent}} = \frac{0.4}{0.6} = \frac{2}{3}$

$n_{solute} = 4$

$n_{solvent} = 6$

Q. The mole fraction of a solvent in aqueous solution of a solute is 0.8. The molality (in mol kg^{-1}) of the aqueous solution is

[2019 Main, 12 April I] (IIT-JEE 2003)

A 13.88×10^{-2}

B 13.88×10^{-1}

C 13.88

D 13.88×10^{-3}

$X_{solvent} = 0.8$

$X_{solute} = 0.2$

$\frac{n_{solute}}{n_{solvent}} = \frac{0.2}{0.8} = \frac{1}{4}$

$n_{solute} = 1$

$n_{solvent} = 4$

$m = \frac{1 \times 10^3}{4 \times 18} = \frac{1000}{4 \times 18} = \frac{250}{18} = \frac{125}{9}$

$= 13.88$

Q. The mole fraction of a solute in a 100 molal aqueous solution $\underline{64} \times 10^{-2}$
(Round off to the Nearest Integer)

[17 March (Shift 1) 2021]

Integer = 4 Marks

Sol^{n}.

$X_{solute} = ?$

$m = 100$

$$\frac{X_{solute}}{X_{solvent}} = \frac{m \times \text{m.wt of solvent}}{10^3}$$

$$\frac{X_{solute}}{1 - X_{solute}} = \frac{100 \times 18}{1000}$$

$$10\,X_{solute} = 18 - 18\,X_{solute}$$

$$X_{solute} = \frac{18}{28} = \frac{9}{14}$$

$$= 0.6428$$

$$= 64 \times 10^{-2}$$

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$C_{SD} = 34$ Relation between mole fraction and molality

given → molality = m

find out → mole fraction = ?

$$\frac{X_{solute}}{X_{solvent}} = \frac{n_{solute}}{n_{solvent}} = \frac{n_{solute}}{W_{solvent}(gram)} \times M.wt\ of\ solvent \times 10^3$$

$$\boxed{\frac{X_{solute}}{X_{solvent}} = \frac{m \times M.wt\ of\ solvent}{10^3}}$$

Q molality of aqueous solution of NaOH is 0.4m

Calculate mole fraction of NaOH

(a) 1.25

(b) 0.72

(c) 0.43

✓(d) None of these

$$\frac{X_{NaOH}}{X_{H_2O}} = \frac{m \times \text{m.wt of solvent}}{10^3}$$

$$\frac{X_{NaOH}}{1 - X_{NaOH}} = \frac{0.4 \times 18}{10^3} =$$

$$1000\, X_{NaOH} = 7.2 - 7.2\, X_{NaOH}$$

$$X_{NaOH} = \frac{7.2}{1007.2} = 0.00714 = 7.1 \times 10^{-3}$$

$C_{SD} = 35$

$$A_xB_y \rightleftharpoons x\,A^{+y} + y\,B^{-x}$$

molality of A_xB_y sol^n. $= m$

molality of $A^{+y} = x \times$ molality of $A_xB_y = x \times m$

molality of $B^{-x} = y \times$ molality of $A_xB_y = y \times m$

Q molality of $Al_2(SO_4)_3$ aqueous solution is 1.2 m.
Calculate molality of Al^{+3} in solution

(a) 1.2 m

(b) 2.4 m

(c) 3.6 m

(d) None of these

molality of Al^{+3} = 2 × molality of $Al_2(SO_4)_3$

= 2 × 1.2

= 2.4 m

Q. A sugar syrup of weight 214.2 g contains 34.2 g of sugar ($C_{12}H_{22}O_{11}$). Calculate (i) molal concentration and (ii) mole fraction of sugar in syrup

(1988)

Home work

Q. A solution of sodium sulphate contains 92 g of Na^+ ions per kilogram of water. The molality of Na^+ ions in that solution in mol kg^{-1} is (Jee-Main 2019

A 16

B 4

C 132

D 8

Home work

Home work

⇒ 2 Question

⇒ DPP. No. = 8

Thank - You